FARMSTEAD WATER SUPPLY MANUAL

RELATING TO THE DEVELOPMENT
OF
FARMSTEAD–LIVESTOCK WATER

In Accordance with the Provisions of
THE WATER FACILITIES PROGRAM

FARM SECURITY ADMINISTRATION
Region VII
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FARMSTEAD WATER SUPPLY MANUAL

1. GENERAL

This Water Supply Manual is prepared for the purpose of assisting County Supervisors, District Supervisors and Area Specialists in the preparation of rural water supply, water facility dockets.

It is our intention to supply general information, sample specifications, and typical designs in this manual. Of necessity only the most general cases have been covered. The material comes from manufacturers specifications, and is representative of average conditions which will be encountered in the field. A County Supervisor with the aid of the manual should be able to prepare an "Estimate of Cost" for most of the farmstead water facility loans. In cases where it is necessary to install a complicated water facility and the County Supervisor would like to have the services of an engineer, such service may be obtained by a request through the State Water Facilities Specialist.

The following are points to be considered in designing a farmstead water facility:

1. Is the supply great enough to take care of present and future needs?

2. Is the system designed to allow running water for the house, either first or second floors, from a pressure system or elevated tank?

3. Is the stock watering tank situated to permit the watering of stock in the lots and pasture?

4. Is the well located away from sources of contamination? (Out of drainage ways, and 100 feet from barns, hog pens, stock lots and outdoor toilets)

5. Is the well sealed from surface contamination?

6. Is a good well curb provided?

7. Can irrigation water be supplied to irrigate a garden?

8. Is soft water necessary for household use?

9. Can well water be used to cool milk before being piped to stock tank?

10. The advice of your local dealer and well driller is usually very reliable and sound.

11. The Water Facilities Manual requires that an engineer design

and submit cost estimate data on such structures as dams, dugouts, spring development and field irrigation.

12. For all contract work use form FSA 498, and where wells are involved use Exhibit A of Form FSA 498 (8-29-42)

2. WATER REQUIREMENTS

The following is suggested as a basis for estimating the size of pumps and other facilities to be installed.

a. For each member of a family.......... 40 gal. per day
b. For each horse or steer.............. 15 gal. per day
c. For each dairy cow................... 30 to 40 gal. per day
d. For each hog......................... 2 to 3 gal. per day
e. For each sheep....................... 1 to 2 gal. per day
f. For each 100 chickens................ 3 gal. per day

3. WELLS

a. Drilled

The diameter of wells is governed by the quantity of water required and by local conditions. Casing diameters varying from 3 inches to 6 inches are recommended. The exact size should be determined by conditions at the site. The casing is to be of sufficient size to permit the installation of the proper cylinder and drop pipe. The depth of the well and cost can be estimated by local drillers, and by investigating the depth of nearby wells. It is always good practice to consult geologists about ground water conditions if they are available.

Wells should be cased their entire length except where the water bearing stratum is overlain with rock. Under such circumstances, the casing need only be extended to the rock and sealed. New casing or its practical equivalent should be used. Second hand pipe previously used in oil or gas development is not satisfactory where potable water is necessary unless the pipe has been steamed out and thoroughly cleaned. Light weight galvanized pipe is not generally recommended except where it has proved satisfactory in the locality. The casing should be set in accordance with the sample specifications listed in the appendix.

If the casing is seated in clay or on non-water bearing rock, a screen or perforated section of casing should be used at the location of the water bearing stratum to permit the water to enter the well. If water is obtained from sand or gravel, a sand screen should be used.

The top of the well should be sealed by means of a reinforced concrete slab as indicated in Figure 1. The slab should be large

enough to serve as a base for the pumping equipment. The casing should extend 6 inches above the natural ground surface and make a water-tight connection with the curb which is usually made 4 inches to 6 inches thick.

b. Dug

These wells are usually shallow and are necessary where the ground water moves slowly through the water bearing material. The well acts as a reservoir to permit longer periods of pumping. Figure No. 2 shows a standard installation. The well is usually from 3 feet to 3 1/2 feet in diameter. The lining under water is 2 inch by 6 inch planks held in place by iron rings. Between the water line and frost line the walls are plastered 1/2 inch thick using a mixture, 6 sacks of portland cement to 1 cubic yard sand. Extending from 6 inches above natural ground to 4 feet below (or to the frost line) a concrete wall 4 feet in diameter and 4 inches thick is poured. The slab may be similar to Figure 1.

4. DROP PIPE

All drop pipe should be standard galvanized pipe. It is advisable to use a pipe having an internal diameter larger than that of the cylinder to permit removal of the valves for repair without pulling the drop pipe. The pipe should extend far enough into water so that the well may be pumped continuously at its rated capacity without danger of exposing the suction stub.

5. CYLINDER

The size of the cylinder is determined by the diameter of the well, pumping rate, depth of well, size of wheel or power unit, and amount of water required.

It is good practice to design the facility to produce two or three times the daily water requirements in a twenty-four hour period when wind is the source of power. Since many wells produce a limited amount of water the size of the cylinder is governed by the capacity of the well. Select a cylinder having a capacity somewhat less than that of the well to insure continuous pumping without lowering the water below the end of the suction line. Table 1 can be used as a guide in selecting the proper size of cylinder for each well. Use as small a cylinder as possible where a hand pump is installed as it is easier to operate.

6. SUCKER ROD

The sucker rod may be made of either steel or wood. The table on page 4 shows common sizes of wood sucker rods and the corresponding pipe sizes:

Number Threads	Octagonal Sucker Rod (inches)	Drop Pipe (inches)	Wt. per 100 feet of rod with joint
12	1 1/8	2	45
10	1 3/8	2 1/2	75
10	1 5/8	3	100
10	1 7/8	3 1/2	150

7. PUMP

Any standard hand pump may be used provided it has a closed top and is adaptable for use with a windmill or pump jack as may be required. The closed top is desirable because it does not allow contamination to enter the pump.

Table II gives the approximate horse power required to pump a given quantity of water with a specified head by electricity. Always select a motor that has more power than is required by the table. When a gasoline engine is used add 50% to the horse power requirement as shown in Table II to get the correct size. Any reliable dealer will give information as to the proper size motor for a particular installation.

8. WINDMILL TOWER

Towers may be built of wood or steel. The tower should be high enough to put the wheel above all obstructions, and clearly within wind currents.

Complete specifications for steel towers are contained in the appendix. They should be used when steel towers are purchased.

Wood towers have the advantage of greater stability during high winds. The windmill head should be grounded to prevent damage to the head or tower from lightning. Plans covering the details of construction of wood towers are outlined in Figures 3 and 4. The foundation posts should be cedar or creosoted posts, and set in concrete. The platform should be large enough to provide ample working space.

9. WINDMILL

The mill should be of standard make and meeting specifications as outlined in the appendix. The average power delivered in a 15 mile wind is listed below:

Size of Mill in feet	6	8	10	12	14	16	18
Horse Power Delivered	.20	.34	.53	.75	1.00	1.35	1.72

Table III gives pumping capacities for a standard mill. Select the proper size mill to go with the cylinder, water required, and elevation to be pumped.

TABLE I

LARGEST SIZE CYLINDER THAT MAY BE USED IN VARIOUS SIZED WELL CASING

A 2-inch Casing will take:
1-3/8-inch Brass Body Flush Cap Cylinder.

A 2-1/2-inch Casing will take:
1-7/8-inch Brass Body Flush Cap Cylinder.

A 3-inch Casing will take:
2-1/2-inch Brass Body Flush Cap Cylinder.

A 3-1/2-inch Casing will take:
2-1/4-inch Brass Lined Cylinder or 3-inch Brass Body Flush Cap Cylinder.

A 4-inch Casing will take:
2-1/2-inch Iron or Brass Lined Cylinder; 3-1/2-inch Brass Body Flush Cap Cylinder.

A 4-1/2-inch Casing will take:
3-inch Iron or Brass Lined Cylinder; 4-inch Brass Body Flush Cap Cylinder.

A 5-inch Casing will take:
3-1/2-inch Iron or Brass Lined Cylinder; 4-inch Brass Body Flush Cap Cylinder.

A 6-inch Casing will take:
4-inch Iron or Brass Lined Cylinder; 4-inch Brass Body Flush Cap Cylinder.

*There are special types of cylinders manufactured that will deviate slightly from the data in the above table. Obtain the advice of local manufacturing representatives when making a final selection.

TABLE II

CAPACITY OF DIFFERENT SIZED CYLINDERS AND HORSE POWER REQUIRED

FOR DIFFERENT TOTAL HEADS - SINGLE ACTING PUMP

SIZE CYLINDER INCHES	LENGTH STROKE INCHES	STROKE PER MIN.	GALLONS PER HOUR	HORSE POWER REQUIRED FOR TOTAL HEAD 25'	50'	75'	100'	125'	150'	200'	400'
2	6	40	196	.062	.124	.186	.248	.31	.372	.496	.992
2	8	40	261	.083	.166	.249	.332	.415	.498	.664	1.328
2	10	40	326	.104	.208	.312	.416	.520	.624	.832	1.664
2 1/4	6	40	247	.079	.158	.237	.316	.395	.474	.632	1.264
2 1/4	8	40	330	.105	.210	.315	.420	.525	.630	.840	1.680
2 1/4	10	40	413	.131	.262	.393	.524	.655	.786	1.048	2.096
2 1/2	6	40	306	.097	.194	.291	.388	.485	.582	.776	1.552
2 1/2	8	40	408	.129	.258	.387	.516	.645	.774	1.032	2.064
2 1/2	10	40	510	.162	.324	.486	.648	.810	.972	1.296	2.592
2 3/4	6	40	370	.118	.236	.354	.472	.590	.708	.944	1.888
2 3/4	8	40	493	.157	.314	.471	.628	.785	.942	1.256	2.512
2 3/4	10	40	617	.196	.392	.588	.784	.980	1.176	1.568	3.136
3	6	40	440	.140	.280	.420	.560	.700	.840	1.120	2.240
3	8	40	587	.187	.374	.561	.748	.935	1.122	1.496	2.992
3	10	40	734	.233	.466	.699	.932	1.165	1.398	1.864	3.728
3 1/4	6	40	517	.164	.328	.492	.656	.820	.984	1.312	2.624
3 1/4	8	40	690	.219	.438	.657	.876	1.095	1.314	1.752	3.504
3 1/4	10	40	862	.274	.548	.822	1.096	1.370	1.644	2.192	4.384

NOTE: THE ABOVE TABLE GIVES THE ACTUAL H.P. REQUIRED FOR OPERATION OF THE PUMP BY AN ELECTRIC MOTOR. IF A GASOLINE ENGINE IS USED, ADD 50% TO THE ABOVE FIGURES. THE POWER STATED IS APPROXIMATE AS IT IS IMPOSSIBLE TO DETERMINE ALL OF THE LOSS OF POWER THAT OCCURS FROM FRICTION. THE CAPACITY GIVEN IN THE ABOVE TABLE IS BASED ON 40 STROKES PER MINUTE. TO FIND THE CAPACITY OF ANY SIZE CYLINDER WITH LESS THAN 40 STROKES PER MINUTE, DEDUCT ONE-FOURTIETH PART OF THE CAPACITY GIVEN FOR EACH STROKE LESS THAN 40 STROKES PER MINUTE.

TABLE III

PUMPING CAPACITIES

BACK-GEARED WINDMILLS FOR VARIOUS ELEVATIONS

THESE CAPACITIES ARE BASED ON A 15-MILE PER HOUR WIND FOR SMALL MILLS AND 18 TO 20 MILES PER HOUR WIND FOR LARGER MILLS. CAPACITIES ARE BASED ON LONGEST STROKE MILLS. IF SHORT STROKE USED, CAPACITIES WILL BE REDUCED IN PROPORTION TO LENGTH STROKE USED.

CYLINDER	6 FT. 5" STROKE		8 FT. 5½" STROKE		8 FT. "A" 7½" STROKE		10 FT. 7½" STROKE		12 FT. 12" STROKE		14 FT. 12" STROKE		16 FT. 16" STROKE		18 FT. 16" STROKE	
SIZE	ELEV.	G.P.H.	ELEV.	G.P.H.	ELEV.	G.P.H.	ELEV.	G.P.H.	ELEV.	G.P.H.	ELEV.	G.P.H.	ELEV.	G.P.H.	ELEV.	G.P.H.
1 7/8	120	115	188	125	172	173	256	140	388	180	580	159	890	183	1,200	172
2	95	130	148	143	135	195	210	159	304	206	455	176	730	209	950	196
2 1/4	75	165	117	183	107	248	165	202	240	260	360	222	576	264	750	247
2 1/2	62	206	98	227	89	304	137	248	200	322	300	276	480	326	625	306
2 3/4	54	248	85	270	77	370	119	300	173	390	260	334	415	394	540	370
3	45	294	72	325	65	440	102	357	147	463	220	396	353	470	457	440
3 1/4	39	346	61	380	55	565	86	418	125	544	187	465	300	552	390	518
3 1/2	34	400	53	440	48	600	75	487	108	630	162	540	260	640	336	600
3 3/4	29	457	46	500	42	688	65	558	94	724	142	620	225	735	292	688
4	26	522	40	575	37	780	57	635	83	822	124	706	198	835	258	780
4 1/4	23	590	36	650	32	884	50	718	73	930	110	795	175	940	228	880
4 1/2	20	663	32	725	29	990	45	805	65	1,040	98	892	157	1,060	203	990
4 3/4	18	735	28	810	26	1,100	40	897	59	1,160	88	993	140	1,170	182	1,100
5	16	815	26	900	23	1,220	36	990	53	1,270	79	1,080	127	1,300	164	1,240
5 3/4	–	–	20	1,180	18	1,620	28	1,330	40	1,696	60	1,450	96	1,720	124	1,610
6	–	–	18	1,290	16	1,756	25	1,450	37	1,850	55	1,580	88	1,880	114	1,760

IF THE WIND VELOCITY BE INCREASED OR DECREASED, THE PUMPING CAPACITY OF THE WINDMILL WILL ALSO BE INCREASED OR DECREASED. CAPACITIES WILL BE REDUCED APPROXIMATELY AS FOLLOWS, IF WIND VELOCITY IS LESS THAN 15 MILES PER HOUR: 12 MILE PER HOUR WIND, CAPACITY REDUCED APPROXIMATELY 20%; 10 MILE PER HOUR WIND, CAPACITY REDUCED APPROXIMATELY 38%. DIRECT-STROKE MILLS USUALLY MAKE MORE STROKES PER MINUTE; THEREFORE, IT IS ADVISABLE TO USE A SMALLER CYLINDER OR A SHORTER STROKE. FOR FIGURING PUMPING CAPACITIES OF DIRECT-STROKE MILLS, USE THE NEXT LARGER SIZE WHEEL. FOR EXAMPLE: AN 8-FOOT BACK-GEARED MILL WILL DO ABOUT THE SAME WORK AS A 10-FOOT DIRECT-STROKE MILL.

Prevailing winds are a factor because a mill with a small cylinder operating, pumps more water than a mill with a large cylinder which is not operating.

10. STOCK WATER SUPPLIES

The recommended method of piping water to a stock tank is shown in Figure 6. Protection from freezing is insured and waste water is carried away to a point where approaches to the tank can be kept dry. Unions are provided at the point where the pipe passes through the bottom of the tank to simplify installation and to permit complete drainage of the tank when desired. The tank should be located at a high point where good drainage of the approaches is assured. A guard is provided to keep livestock from stepping into the tank.

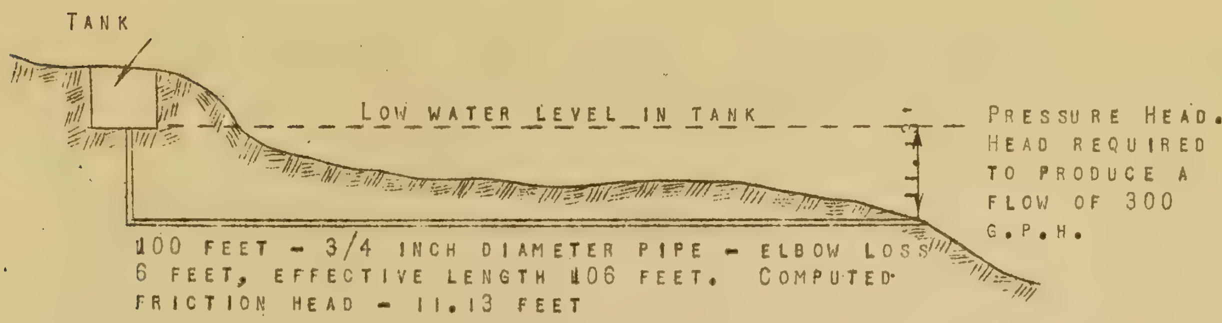
In many instances it is convenient to locate hydrants at various points about the farmstead. All hydrants should be equipped with self drain valves, located below the frost line to prevent freezing.

11. PIPE FRICTION

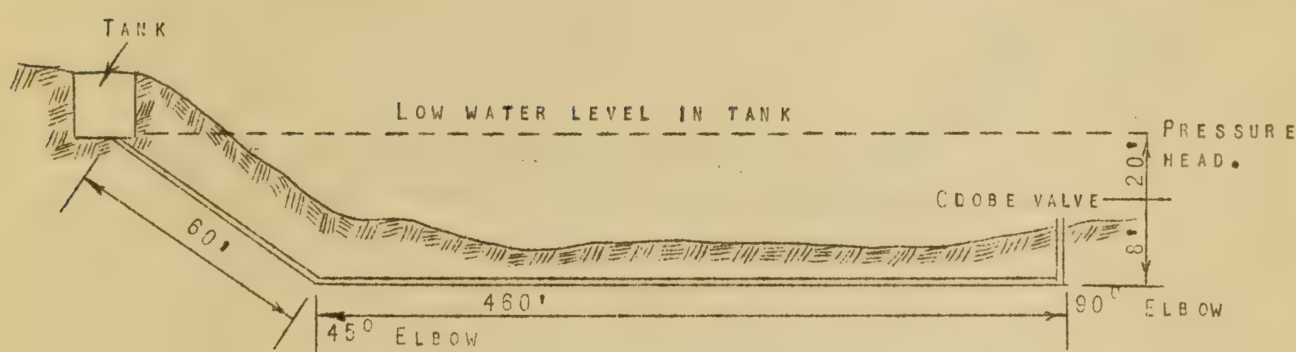
Pressure is required to force water through a pipe due to the friction that is developed by water coming in contact with the inside surface of the pipe. Pressure is generally stated in pounds per square inch, which is readily converted into feet of head by multiplying the pressure in pounds per square inch by 2.31. This is called pressure head. The simplest way to create pressure head in a water system is to pump the water into an elevated storage tank. The difference in elevation between the water surface in the tank and the outlet is known as pressure head. In this manual the pressure will be stated in terms of equivalent feet of head. The loss of head due to friction in a pipe or friction head is proportional to thelength of pipe, roughness of the pipe, the square of the velocity, and is inversely proportioal to the diameter of the pipe. Friction also occurs when water flows through elbows, valves, and other pipe fittings in the system. Table IV gives the friction loss per 100 feet of various sizes of pipe based on pipe in use for fifteen years laid in a straight line when discharging a given quantity of water. To obtain the friction loss for any other length of pipe, multiply the value of friction loss as shown in the table, by the length of pipe desired and divide by 100. $\left(\frac{\text{Actual length X friction loss}}{100}\right)$

To illustrate the principle of pipe friction, determine the head required to discharge 300 g.p.h. (gallons per hour) through 100 feet of 3/4 inch diameter pipe and one 3/4 inch 90° elbow. To find the friction loss, refer to Table IV, enter the column headed "Gallons of Water Entering Pipe per Hour" follow the 300 g.p.h. capacity horizontally to the right to the 3/4 inch column. The friction loss is shown to be 10.5 feet. To find the friction loss in the 3/4 inch 90° elbow in Table IV under "Friction Loss in Fittings Equivalent to Lengths of Same Size Pipe", enter column headed "Size" to 3/4 inch and follow to the right under 90° elbow, where we find 6.0 feet additional length of pipe. This makes the effective length of pipe 106 feet. Using the

formula $\frac{\text{Actual Length X Friction Loss}}{100}$ we have $\frac{106 \times 10.5}{100}$ equals $\frac{1113}{100}$ or 11.13 feet the necessary difference in elevation to get 300 gallons per hour from a 3/4 inch pipe. A graphical illustration is shown below.



12. COMPUTATION OF PIPE SIZES

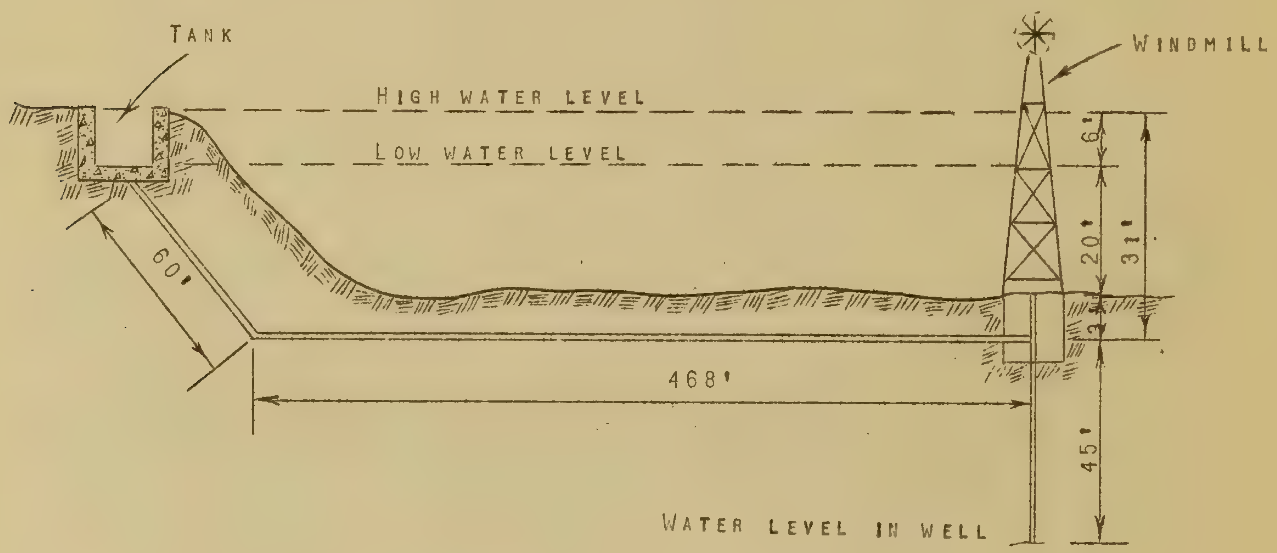


The above sketch represents graphically the conditions outlined in the following problem. The problem is to determine the size of pipe necessary to discharge 600 g.p.h. at the outlet from an elevated tank. Assume 1 1/4 inch pipe size. The total length of pipe is 528 feet and the line has the following fittings with corresponding loss of head.

through each fitting:

1-globe valve at outlet 1 1/4 inch	9.0 feet
1-90° elbow	8.0 feet
1-45° elbow	4.0 feet
	21.0 feet

Effective length of pipe 528 feet + 21 feet is 549 feet. To find the friction loss refer again to Table IV. Enter the column headed "gallons of water entering pipe per hour" at 600, follow to the right to the 1 1/4 inch column where we find the friction loss to be 3.05 feet for each 100 feet of pipe. The total friction head loss would be $\frac{549 \times 3.05}{100}$ equals 16.75 feet. Our computation shows that there must be a difference in elevation of 16 3/4 feet to maintain a flow of 600 g.p.h., but since there is actually a 20 foot head water should flow under a head of 3 1/4 feet, which will deliver a little more than the 600 g.p.h. required.



As an added example, consider a windmill pumping into an elevated tank. The problem is to determine the size of mill required and the size of pipe to use to pump water into the elevated tank. The water in the well is 50 feet below the surface and the water requirement has been set at 600 g.p.h. Below are listed items considered in the design.

1-1 1/4 inch "T" (same as 90° elbow)	8.0 feet
1-1 1/4 inch 45° elbow	4.0 feet

1-1 1/4 inch check valve	8.0 feet
1-1/4 inch pipe	528.0 feet
	548.0 feet

$\frac{548 \times 3.05}{100}$ - 16.7 feet loss in head

The mill is required to pump against a head as listed below:

Friction head	16.7 feet
Water level to discharge level	45.0 feet
Discharge level to high water surface	31.0 feet
Total pumping head	92.7 feet

From Table III we find that a 12 foot mill with a 12 inch stroke using a 3 1/2 inch cylinder will pump 630 g.p.h. under a 108 foot head.

In order to show the importance of selecting the proper size pipe we will design the same system using 1 inch pipe.

1-1 inch "T" (same as 90° elbow)	6.0 feet
1-1 inch 45° elbow	3.0 feet
1-1 inch check valve	5.0 feet
1 inch pipe	528.0 feet
Total equivalent length of pipe	542.0 feet

$\frac{542 \times 11.70}{100}$ - 63.4 feet loss in head

Friction head	63.4 feet
Water level to discharge level	45.0 feet
Discharge level to high water surface	31.0 feet
Total pumping head	139.4 feet

Referring to Table III it would require a 14 foot mill with a 12 inch stroke and a 3 3/4 inch cylinder to deliver the same amount of water through a 1 inch pipe.

There are two points to consider in the design of a system; the smaller pipe costs less than the larger pipe, the smaller pipe requires a larger and correspondingly higher cost pump which results in higher pumping cost. For any particular system a proper balance between cost of pipe and pumping costs should be met.

Listed below are usual depths pipe must be buried to prevent freezing.

Kansas	2 1/2 feet to 4 1/2 feet
Nebraska	4 feet to 5 1/2 feet
South Dakota	5 feet to 7 feet
North Dakota	5 feet to 9 feet

13. STORAGE TANKS AND TOWERS

TABLE IV

FRICTION LOSS IN STRAIGHT PIPE AND FITTINGS

Gallons of Water Entering Pipe per Hour	1/2"	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"
	Friction Loss in Feet for Each 100 Feet of Pipe in Use for 15 Years							
60	2.10	.49						
120	7.40	1.90						
180	15.80	4.10	1.26					
240	27.00	7.00	2.14	0.57	0.26			
300	41.00	10.50	3.25	0.84	0.39	0.12		
360	54.86	14.15	4.39	1.15	0.52	0.17		
420		18.19	5.63	1.61	0.75	0.23		
480		24.05	7.50	1.93	0.89	0.32		
540		28.58	9.04	2.45	1.18	0.38		
600			11.70	3.05	1.43	0.50	0.17	0.07
720			15.76	4.13	1.93	0.66	0.27	0.10
900			25.00	6.50	3.00	1.08	0.36	0.15

FRICTION LOSS IN FITTINGS EQUIVALENT TO LENGTHS OF SAME SIZE PIPE

Size	Type of Fitting						
	90° Elbow	45° Elbow	Gate Valve	Globe Valve	Check Valve	Strainer	Foot Valve
1/2"	5.0	2.5	1.0	7.5	5	10	5
3/4"	6.0	3.0	1.2	9.0	5	10	5
1"	6.0	3.0	1.2	9.0	5	15	5
1 1/4"	8.0	4.0	1.6	12.0	8	15	8
1 1/2"	8.0	4.0	1.6	12.0	8	20	8
2"	8.0	4.0	1.6	12.0	8	20	8
2 1/2"	11.0	5.5	2.2	16.5	10	25	10
3"	16.0	8.0	3.2	24.0	12	25	12

To compute the friction losses in terms of pounds pressure instead of feet head, multiply above figure by .434

Exposed tanks (See Figure 5) are not generally recommended for this region due to the difficulty experienced through freezing in the winter. If it is desirable to use an exposed tank, a considerable quantity of water should be pumped into, and removed from the tank daily in order to prevent damage due to freezing, during sustained cold periods. The riser pipe to a tank on a tower should be boxed in by a double thickness of lumber or insulation leaving an air space of at least six inches around the pipe. This space should not be packed with straw, sawdust or other materials. The tank should have a capacity of 1 1/2 or 2 times the daily water requirements. The minimum capacity should be approximately 1500 gallons. The use of Cypress or Redwood is recommended for wooden tanks. Where topography permits concrete, brick or plastered tanks may be put below the ground at an elevation that will permit gravity flow through the system. These structures are discussed more completely under cisterns. Plans are shown in Figures 7, 8 and 9.

Under conditions where there is not sufficient elevation to install a gravity flow, a pressure system can be installed. An electric motor-driven deep well pump connected to a pneumatic tank affords the most practical system. Electric power is quite essential if continuous flow is to be provided with little storage capacity, as this type is readily adaptable to automatic starting and stopping due to pressure variations.

Wood is the most economical material to use in the construction of the tower. The tower should be strong enough to hold the tank and water and be well braced to prevent damage from high winds.

The top of the tower should be high enough to provide 6 feet of head in addition to friction head, above the highest outlet. An example showing losses by friction in pipes is shown on page ten. For example if all the friction losses from the storage tank to the highest outlet is equal to 14 feet, then the tower should be 14 feet plus 6 feet or 20 feet above the elevation of the highest outlet. A plan showing typical construction and specifications is shown in Figure 5. If no other source for cooling milk is available the tower can be readily enclosed to provide an excellent milk house to cool and keep milk and dairy products sanitary.

15. CISTERNS

Rain water is soft and comparatively pure but it must be carefully collected and stored or it will not remain in this condition. The most common place to collect rain water is from the roof of the house and other buildings. The roofs are often contaminated with various materials, such as dust, soot, leaves, vermin and bird droppings. For this reason it is advisable to allow the roof and spouting to be thoroughly washed off before any water is turned into the cistern inlet. To give additional assurance of a good clean water supply, a good filter of clean, well selected materials should be used to pass the water through before it enters the cistern. Another vital feature is absolute water tightness of the top, sides and bottom of the cistern. All inlets, outlets and over flow pipes should be screened and inspected regularly.

A cistern filter is for removing inert matter that may be carried in suspension in rain water from roofs of buildings or eves spouting. To be effective, the water must slowly filter through fine, clean filtering materials. For good results the rates of filtration should not exceed 50 gallons in 24 hours for each square foot of effective filter bed. Filtering materials should include 2 feet of clean well washed fine sand on top, a 6 to 10 inch layer of well burned charcoal crushed to pea size, and a thin layer of coarse gravel on the bottom. As the surface layer of sand becomes clogged some of it may be scraped off occasionally. The sand bed should never be allowed to become less than 12 to 15 inches thick. At least once each year all the filtering material should be removed and replaced with clean, fresh materials.

If cistern water is to be used for drinking purposes, extra precautions must be taken. The filter should be cleaned frequently. The cistern should be drained and scrubbed clean regularly, and sterilized with a chlorine solution.

Wood, galvanized iron, brick and concrete are all common materials used for the construction of cisterns. Cisterns constructed of wood or galvanized iron are generally cheaper and are placed on top of the ground or on the basement floor but they do not make a permanent type of cistern. Over a period of years storage costs are usually less for either a brick or a concrete cistern.

Brick cisterns are satisfactory and can be constructed without the use of forms, but skilled labor is necessary for laying the brick. It is necessary to plaster the inside wall with rich concrete mortar to make it water tight.

In many localities concrete is becoming the most popular material to use for the construction of cisterns. Only an inside form is usually necessary, the earth being the outside form. The walls should be 6 inches thick, and for diameters up to 8 feet no reinforcing is necessary.

The soil in many areas is such that a reasonably durable cistern can be made by plastering directly on the earth wall. It is of course necessary to construct the upper part of a plastered cistern of reinforced concrete or brick to withstand extra pressures such as frost action and any live loads which may be near the cistern.

See Figure 7, 8, and 9 for plans of several types of cisterns.

The size of a satisfactory cistern for any farm will depend upon three factors (1) The requirements of the household (2) the amount and distribution of rainfall and (3) the amount of roof area that is used to collect water. In general we do not recommend the construction of any cistern less than 2000 gallons, which is approximately 8 feet deep and 7 feet in diameter.

16. HYDRAULIC RAMS

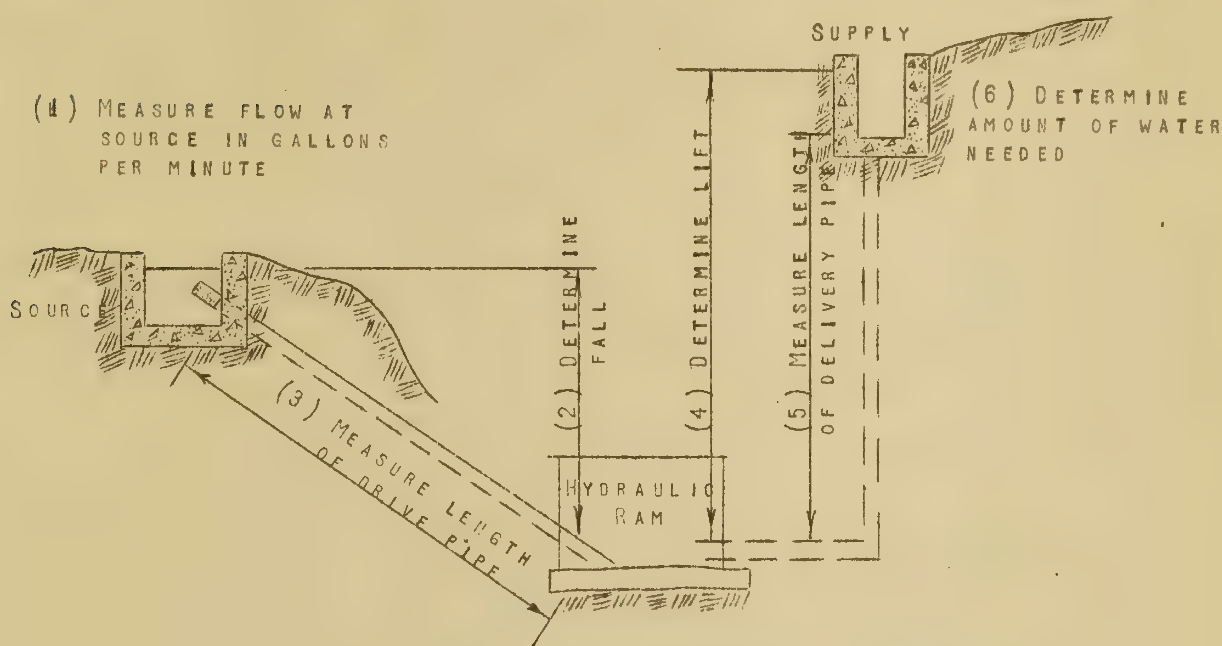
Where an adequate supply of potable water is available under special conditions such as flowing springs, a hydraulic ram may provide a practical method of pumping water to points of storage or use, Minimum conditions for hydraulic ram operation are:

1. Not less than 24 inches fall between source and ram.
2. At least 25 feet of drive pipe.
3. Flow of at least 1 gallon per minute at source.

Maximum conditions for hydraulic ram operation are:

1. Not over 16 feet fall between source and ram.
2. Not over 250 feet of drive pipe.

Before a hydraulic ram is installed certain necessary information should be secured as indicated in the sketch below, and sent to the engineering division.



A simple formula for computing the approximate delivery of water is as follows:

$$\frac{V \times F \times 40}{E} = Q$$

V = gallons of water at source in gallons per minute.
F = fall in feet from source to ram.
E = vertical elevation in feet through which water is to be raised.
Q = quantity of water the ram will deliver in gallons per hour.

17. CONCRETE

All concrete used in pump foundations or well caps should be mixed in the proportion of 1 part cement, 2 parts sand and 4 parts gravel. This mix will require 6 sacks of cement, 12 cubic feet of sand and 24 cubic feet of stone to produce 1 cubic yard of concrete. If pit run material is used, a mix of 1 part cement to 4-1/2 parts sand and gravel will be satisfactory. Use only enough water to produce a workable mix. Usually 5 to 7 gallons per sack of cement (depending on the moisture content of the aggregate) will give satisfactory results. A thin sloppy mix produces poor quality concrete.

The design of concrete mixtures used in water tanks, storage reservoirs, pump pits and other water-tight structures should be made by a competent engineer. The above mentioned mixtures are not satisfactory for this class of work. Generally a mix of 1:2:3 is required to produce durable water-tight concrete. A reduction in volume of coarse aggregate is necessary to produce a dense mix. Competent engineering services are also required in designing and building the structure.

18. CONTRACT

A sample "Well Drilling Contract" form FSA 498, is exhibited on page 22. This form has administrative approval and should be used in all cases involving the drilling of a well. It should be supported by Exhibit A of form FSA 498.

The distribution of form FSA 498 is as follows:

a. Executed original to contractor.
b. Executed copy to borrower.
c. Conformed copy to county office.

The distribution of Exhibit A of form FSA 498 is as follows:

a. Two copies to Regional Water Facilities Engineer.
b. One copy to State Water Facilities Engineer.

APPENDIX

COST ESTIMATE SCHEDULE

1. _____ persons at _____ gal./day _____ Gal.
2. _____ horses or steers _____ gal./day _____ Gal.
3. _____ dairy cattle _____ gal./day _____ Gal.
4. _____ hogs or sheep _____ gal./day _____ Gal.
5. _____ chickens _____ gal./day _____ Gal.
6. Garden Irrigation _____ gal./day _____ Gal.

TOTAL WATER REQUIREMENT.............. Gal./day _____

WELL

1. Drilling _____ in. diam., _____ ft. @ $ _____ per ft. $ _____
2. Casing _____ in. diam., _____ ft. @ $ _____ per ft. $ _____
3. Strainer or screen $ _____

TOTAL COST OF WELL............................ $ _____

PUMP COMPLETE

1. Pump _____ @ $ _____ $ _____
2. Drop Pipe ___ in. diam. ___ ft. @ ___ per ft. $ _____
3. Fittings $ _____
4. Sucker rod _____ ft. @ _____ per ft. $ _____
5. Cylinder, size _____, stroke _____ $ _____
6. Screen $ _____

TOTAL COST PUMP INSTALLATION...,............. $ _____

POWER

1. Windmill tower_____ht. Ft._____material $_____

2. Windmill___________size, ft. $_____

3. Gasoline motor $_____

4. Electric motor $_____

5. Pump Jack $_____

TOTAL COST.................................... $_____

MISCELLANEOUS

1. Tank - stock water $_____

2. Tanks - storage $_____

3. Pipe_____diam. in._____ft. @ $_____ $_____

4. Concrete base_____C.Y. @ $_____ $_____

5. ______________________________ $_____

6. ______________________________ $_____

7. ______________________________ $_____

8. ______________________________ $_____

9. ______________________________ $_____

10. ______________________________ $_____

TOTAL COST, MISCELLANEOUS........................ $_____

Contingencies, 10%...................... $_____

GRAND TOTAL..................................... $_____

DISINFECTION OF NEW EQUIPMENT

(Taken from Engineering Handbook, Sanitary Standards for Rural Water Supplies and Systems, April,,1940.)

Whenever a new source of drinking water is developed, whether it be a spring, well, cistern, or storage tank, it must be thoroughly disinfected before being put into use. This disinfection must not be confused with the sterilization of water in connection with treatment. It is done to assure the cleansing of all new equipment and construction.

Disinfection can be done with calcium hypochlorite, better known as chlorinated lime or bleaching powder, containing 30 per cent available chlorine, or high test hypochlorite, commonly called "H.T.H.", or Perchloron, containing approximately 65 per cent available chlorine. A solution of approximately 50 p.p.m. (parts per million) available chlorine should be used to effect complete and proper disinfection of all interior walls of springs and wells. The interior of new cisterns and storage tanks should also be scrubbed down with a similar solution. In the case of wells, in order to have the side walls thoroughly washed down it is advisable to pump the solution back into the well.

The following table is given to assist in obtaining proper mixtures for disinfecting wells or other sources of supply. The solution may be mixed in a clean container of 30 to 50 gallon capacity and then siphoned or poured into the well or encasement.

Chart for dosages of 50 parts per million

Capacity of well in gallons	50	100	200	300	400	500	1000
Ounces of chlorinated lime	1.3	2.6	5.2	7.8	10.4	13.0	26.0
Ounces of H. T. H. or Perchloron	0.5	1.0	2.0	3.0	4.0	5.0	10.0

One ounce = 2 level tablespoonfuls: 3 teaspoonfuls = 1 tablespoon.

In some instances, it may be possible to effect a more complete dis-

infection of a drilled well by using a perforated can on a rope. The chlorinating powder can be placed in the can and the can weighted so as to reach the bottom of the well. By pulling the can back and forth through the water in the well all the powder will be finally dissolved and the water thoroughly sterilized. In every instance a slight taste and odor of chlorine should be noticeable in the water immediately after disinfection.

The following table gives the various well and storage tank sizes to assist in computing the quantity of water to be treated under various conditions:

Well and storage tank capacities in gallons.

Diameter of well	2"	4"	6"	8"	10"	12"			
Gallons of water per vertical foot	.16	.6	1.5	2.6	4.1	6.0			
Diameter of storage tank	2'	3'	4'	5'	6'	7'	8'	9'	10'
Gallons of water per vertical foot	24	53	94	147	212	288	376	477	590

In order to get the total number of gallons of water in any circular well, cistern, or storage tank, take the quantity given in gallons in the above table for one vertical foot of the container and multiply by the total vertical foot of water.

Form FSA 493
8-29-42

Page 1

WELL DRILLING CONTRACT

THIS AGREEMENT made this ____ day of __________, 19___, by and between ______________________________ whose address is ______________ Street, City of ______________, County of ______________, State of ______________ (hereinafter called the "Buyer") and ______________________________ whose address is ______________ Street City of ______________, County of ______________, State of ______________ (hereinafter called the "Contractor"):

W I T N E S S E T H

For and in consideration of the mutual covenants herein contained, the parties hereto agree as follows:

(1) This Agreement is predicated upon the Buyer's application to the Farm Security Administration, United States Department of Agriculture, for an advance of funds to finance the work to be performed under this Agreement; and, in the event such application shall be denied, the Buyer may terminate this Agreement without penalty, and recover all moneys which he may previously have paid to the Contractor pursuant to this Agreement; and, in the event such application shall not have been approved prior to the Contractor's receiving notice to proceed as provided in paragraph (4) below, the Contractor may terminate this Agreement without penalty, upon refunding such moneys as the Buyer may previously have paid pursuant to this Agreement.

(2) The Contractor shall drill, sink, case and complete a well, at a point selected by the Buyer on a certain tract of land located in the County of ______________, State of ______________ more particularly described as follows:

(3) The Contractor shall furnish all tools, labor and machinery necessary to drill said well, to install and perforate the casing, and to develop and test the well in a workmanlike manner. In the event a dry hole shall result, the casing shall be removed, if in place, and the hole filled and plugged; provided, that the casing shall not be removed if the cost of the removal will exceed the salvage value of the casing.

(4) The Contractor shall (subject to his right to cancel, under paragraph (1) above) commence work within ______ days after receiving written notice to proceed, and shall complete the work within ______ days after receiving such notice. If the Contractor shall fail or

refuse to commence work within the time specified therefore, or to complete the work within the time specified therefor, the Buyer may, upon written notice to the Contractor, require the Contractor to forego or cease performance. In such event the Buyer may complete the well himself or by contract, and the Contractor shall be liable for any resulting increase in cost to the Buyer, but this shall not be construed to exclude any other remedy which the Buyer may have.

(5) After said well has reached a depth of ______ feet, or solid rock has been encountered, the Buyer may at any time stop further work thereon, by giving the Contractor notice in writing.

(6) The inside diameter of the casing of said well at starting shall be __________ inches, and shall so continue to a depth of ______________ feet; from __________ feet to __________ feet the casing shall be not less than __________ inches; from __________ feet to __________ feet the casing shall be not less than __________ inches; provided, that if the drilling shall encounter solid rock, bowlder strata, or other formations which shall make it impracticable to drill a hole large enough to install casing of the specified sizes, the Contractor shall use casing of the largest practicable size; but in no case shall the Contractor reduce the size of casing without written authorization from the Buyer, and in no case shall the casing be less than __________ inches (inside-diameter) to a depth of __________ feet, provided, that if the drilling shall encounter strata in which casing shall be unnecessary, the Contractor, at the option of the Buyer, shall eliminate the use of casing in such strata.

(7) The casing to be used in said well shall be what is known as ______________________ steel casing, ______________
(galvanized, screw, red hard, etc.) (single or
______________ of ______________________________ and
double) (gauge or pounds per foot)
shall be furnished and delivered by the ______________________ at
(Contractor or Buyer)

______________________________.
(rail point or well site)

(9) Hauling of casing and starters from ________________ to the well site shall be at the expense of the ____________________
(Contractor or Buyer)
and the returning of any unused material shall be at the expense of the ______________________.
(Contractor or Buyer)

(10) The well shall be drilled in a workmanlike manner, conforming as nearly as practicable to a true vertical alignment, and the alignment shall, in any case, permit the installation and operation of the pumping equipment, without binding, rubbing, or other interference; provided, that, if the Contractor shall fail to meet this

requirement, the Contractor shall correct the alignment or drill a new well, at no additional cost to the Buyer.

(11) Drilling and installation shall be under the supervision of the Farm Security Administration and final payment by the Buyer shall be subject to the acceptance of the work by the Farm Security Administration and by the Buyer.

(12) After the casing has been installed, the Contractor shall perforate said casing at all strata selected by the Farm Security Administration and approved by the Buyer; and the Contractor shall furnish all necessary equipment and labor to sand-pump and develop the well, as the Buyer shall direct.

(13) All sand, rock, earth, mud, water, etc., from the bore shall be discharged in the vicinity of the well, and the Contractor shall not be required to remove such accumulation.

(14) The Contractor shall take samples of materials (one cubic foot each) and samples of water (one gallon each) from all water-bearing strata, and shall keep them in suitable containers (labeled according to the depth below the surface, and the thickness, of the strata) for inspection by the Buyer and by the Farm Security Administration at all times.

(15) The Contractor shall keep a complete and accurate log of the daily progress of the well (following the form of Exhibit "A" attached hereto), including a description of all materials passing through the bore, of all strata penetrated (showing depth and thickness of each stratum), of changes in diameter of the bore and casing (with depths at which they occurred), and of the locations type, and extent of perforations in the casing; and the Contractor shall furnish to the Farm Security Administration and the Buyer certified copies of such log, prior to acceptance of the work by the Farm Security Administration and by the Buyer.

(16) All materials furnished by the Contractor shall be new, unless otherwise specified herein, and shall be free from apparent defects. The Contractor shall provide the Farm Security Administration and the Buyer an opportunity to inspect all materials prior to installation, and shall replace all defective materials at the Contractor's expense; provided, that the Buyer shall make all claims for replacement prior to installation.

(17) The Buyer shall furnish, at the well site, all water necessary for drilling purposes.

(18) The Buyer shall pay the Contractor as follows:

(a) For freight, cartage, transportation, and other costs of moving the well rig, labor, and equipment to the well site, $________.

(b) For the necessary starters and shoes used in drilling the well, $__________ each.

(c) For casing, if furnished by the Contractor, according to the following schedule:

________________ diameter ________ at $__________ per foot
(kind)

________________ diameter ________ at $__________ per foot
(kind)

________________ diameter ________ at $__________ per foot
(kind)

________________ diameter ________ at $__________ per foot
(kind)

(d) For drilling, according to the following schedule:

$__________ per foot for each foot between ______ feet and ______ feet.
$__________ per foot for each foot between ______ feet and ______ feet
$__________ per foot for each foot between ______ feet and ______ feet
$__________ per foot for each foot between ______ feet and ______ feet
$__________ per foot for each foot between ______ feet and ______ feet

The price per foot shall increase $_____ per foot for each ______ foot increase in depth thereafter. (All measurements to be taken from the surface of the ground.)

(e) If the drilling shall encounter a solid-rock stratum which shall not have been penetrated after (5) hours of continuous drilling, the Contracter, at his option, shall be paid at the rate of $________ per hour for the time actually consumed in drilling through such stratum (exclusive of the cost of casing); and the number of feet so drilled on the hourly basis shall not be computed in accordance with Paragraph 18 (d) in calculating the total payment.

(f) For perforating the casing, $_____ per foot; and for sand-pumping and developing the well, $_____ per hour (up to a maximum of 8 hours.)

(19) Payment shall be made under this Agreement as follows:

$_____ upon the signing of this Agreement. Payment for items stated in Paragraph 18 (a), (b) and (c) shall be due within ten (10) days after drilling has commenced. Payment for items stated in Paragraph 18 (d), (e) and (f) shall be due upon final acceptance of the work by the Farm Security Administration and by the Buyer, provided, that such acceptance shall not be delayed longer than ninety (90) days after

the completion of the well or after the Buyer has given notice to cease further work thereon, except for reasonable cause. All unused materials furnished by the Contractor shall revert to him and shall be credited to the Buyer's account at the same price charged by the Contractor.

(20) Delays occasioned by strikes, fires, or other causes beyond the Contractor's or Buyer's reasonable control, shall not be construed as breaches of this Agreement; and the Contractor shall not be liable for such consequential damage as might result from a diminution or failure of crops or a shortage of water, in the event of a breach of ~~this~~ Agreement by the Contractor.

(21) The regulations promulgated by the Secretary of Labor, pursuant to the Act of June 13, 1934 as amended (40 U.S.C. 276b-276c), prohibiting enforced rebates of wages, shall be expressly part of this Agreement; and the Contractor and all sub-contractors shall be subject, in all respects, to the provisions of said statute and regulations.

(22) All disputes between the Buyer and the Contractor shall, if they shall fail to reach a compromise, be referred to an authorized representative of the Farm Security Administration, whose decision shall be final.

(23) This Agreement, executed in triplicate, together with the Engineering Plans and Specifications prepared by the Farm Security Administration, if any, shall be deemed to express all the terms of the understanding between the Buyer and the Contractor, and no amendment hereof shall be binding unless reduced to writing, signed by both parties hereto, and approved by the Farm Security Administration.

(24) The Contractor shall carry compensation insurance sufficient in form and amount to cover his full liability under the Workmen's Compensation Act, and shall carry public liability insurance in an amount sufficient to pay $\$$__________ for injuries to an individual, and $\$$__________ for any one accident.

(25) The Contractor shall save harmless the Buyer and the owner of the premises from any and all liens for materials or labor supplied pursuant to this Agreement, and shall post and keep posted sufficient notice of non-responsibility of the Buyer and the owner of the premises; and, before final payment shall be made by the Buyer, the Contractor shall present satisfactory evidence that all bills for labor and materials employed under this Agreement have been paid in full.

(26) Before drilling shall begin, the Contractor shall provide a satisfactory bond in the sum of ______________________ ______________ Dollars ($________) for the faithful performance by the Contractor under this Agreement.

IN WITNESS WHEREOF, the parties have executed this Agreement as of the day and year first above written.

SIGNED ______________________
(Contractor)

SIGNED ______________________
(Buyer)

WITNESS:

____

____

NOTE: This form provides only for the drilling of a well. If the Buyer desires to have the pump installed, concrete base built, windmill or motive power installed, use page 29 as an addendum.

EXHIBIT "A" OF FORM FSA 498
(8-29-42)

UNITED STATES DEPARTMENT OF AGRICULTURE
FARM SECURITY ADMINISTRATION
WATER FACILITIES PROGRAM

WELL SCHEDULE

F.S.A. AREA ______ W.F. AREA ______
LAND OWNER ______ ADDRESS ______ WELL NO. ______
LOCATION: STATE ______ COUNTY ______ ¼ SEC.
SOURCE ______ CONFIDENTIAL ______
DRILLING COMMENCED ______ COMPLETED ______
DRILLER ______ ADDRESS ______
TOPOGRAPHY ______
ELEVATION ______ FT. DATUM ______ MEAS. POINT ______
TYPE OF WELL ______ METHOD OF DRILLING ______
DEPTH ______ DIAMETER: TOP ______ BOTTOM ______
CHIEF ACQUIFER ______ FROM ______ TO ______
OTHERS ______ T N/S R E/W

CASING: TYPE ______ DEPTH ______ DIAMETER ______ SCREEN ______

WATER LEVEL ______ FT. ABOVE/BELOW ______ ; ______ FT. ABOVE/BELOW ______
PUMP ______ POWER ______
YIELD ______ DRAWDOWN ______ FT. PUMPING ______ G.P.M. TIME ______
USE ______ QUALITY ______ SAMPLES ______

GRAPHIC LOG — GEOLOGICAL FORMATION RECORD — WRITTEN BY: ______ CORRELATION BY: ______ — CASING RECORD

FROM FEET	TO FEET	THICKNESS FEET	CHARACTER OF FORMATION AND REMARKS

SCALE 1" = ______ FEET

NOTE: INDIVIDUAL CASING LENGTHS SHOWING COUPLING LOCATIONS SHOULD BE RECORDED.

SCALE 1" = ______ FEET

BID SCHEDULE

WELLS

DOMESTIC AND LIVESTOCK

1. Drilling well - estimated ________ feet   Per Foot $________

2. Providing and setting ________ inch casing   Per Foot $________

   Estimated amount ________ feet.

3. Providing and setting ________ feet of

   ________ inch diameter perforated casing   Per Foot $________

4. Building concrete pump base   Lump Sum $________

5. Installing pump complete with motive power,

   which shall be ______________________________

   ____

   ______________________________   Lump Sum $________

If awarded the contract I will use ____________________ Casing.

____
Signature of Bidder

FARM SECURITY ADMINISTRATION

WATER FACILITIES PROGRAM

S P E C I F I C A T I O N S

for

WINDMILLS AND TOWERS

D. SPECIFICATIONS

The windmill and tower called for by these specifications shall be sturdily designed and constructed so that it will have long life and be rust resistant. It shall be new, of current model and a standard product, complete with all accessories as regularly furnished to the farm trade, except for such additions or omissions as may be called for in the specifications.

Parts found to be not of current or standard production or parts defective in material or workmanship shall be replaced free of charge at any time during the first year by the manufacturer.

A ten percent (10%) variation in windmill and tower sizes will be acceptable providing the units offered otherwise meet the specifications. The windmills and towers must be of the heaviest type manufactured by the bidder.

D-1 Windmill

D-1a. Type. The windmill shall be of the self-oiling type with heavy duty durable gears. The oiling system must be such that it will thoroughly lubricate all bearings and working parts without attention except once in every twelve months. Adequate provision must be made for preventing loss of oil from the gear case. Complete instructions for operation and care must be supplied by the successful bidder.

D-1b. Size. The windmill wheel shall be approximately ________ feet in diameter.

D-1c. Bearings. Shall be self-oiling and either ball, roller, removable plain babbitt or bronze bearings, or equal.

D-1d. Turntable. Must be freely operating sensitive to light breezes, with self-aligning bearings protected from the weather.

D-1e. Governor. Must be automatic so that the mill will operate in high winds without damage.

D-1f. Brakes. Must be positive and of adequate construction to stop and hold the wheel without jerking or grabbing. Other satisfactory means of preventing the operation of the windmill engine when pulled out of gear will be considered.

D-1g. Furling Device. Must be easily operated and sufficiently sturdy to give long life and to control the mill at all times. A spring bumper is required to absorb the shock when the wheel is turned into the wind. The pull-out wire shall be so located as to prevent excessive wear from contact with the pump rod.

D-1h. Sails. Must be constructed of heavy gage sheet steel, well formed and securely fastened to hold their shape permanently and resist severe winds.

D-1i. Gear Covers. Gear boxes or covers shall be of sturdy construction, weather and waterproof. Due to the fact that the oil is changed only at long intervals it is essential that all w orking parts be kept as dust and waterfree as good design and construction will permit.

D-1j. Galvanizing. All exposed areas of windmill except those iron surfaces that are ordinarily painted shall be heavily galvanized or otherwise treated in an approved manner for permanent protection against rust and weather. Galvanizing must not be damaged by the manufacturer in assembly of the wheel. The galvanizing shall be by the hot process and consist of a heavy coating of spelter of not less than 1 1/4 ounces per square foot, evenly and uniformly distributed over all surfaces of exposed metal parts. The spelter shall be applied in such a manner that it will not peel off in transportation or in the course of erection. Any spelter which peels, cracks or blisters under ordinary handling shall be prima facie evidence of poor workmanship and cause for rejection. All bolts, nuts, braces, etc., shall be galvanized or cadmium plated. The galvanizing and metal shall be in accordance with A. S. T. M. standard A-93-38T, or Federal Specifications QQ-I-696 where applicable for Type II, Class C Steel and the test for galvanizing shall be by the triple spot test.

D-2 Tower.

D-2a. Type I. Shall be of the four post type of sufficiently sturdy design to withstand a wind pressure of thirty pounds per square foot of projected area of tower and windmill. It shall be furnished complete with ladder securely fastened to the tower; substantial platform properly located to permit ready access to motor for repairs and upkeep work; pump pole; long anchor posts and substantial anchors; and complete instructions for

erection. The steel shall comply where applicable with Federal Specifications QQ-S-751a for grade C structural steel.

Type II. Stub Tower. Shall be of the four post type of sufficiently sturdy design to withstand a wind pressure of thirty pounds per square foot of projected area of stub tower and windmill. It shall be constructed in a manner that will permit secure attachment to a wood or steel tower.

D-2b. Size. The tower shall be approximately ________ feet in height, with a minimum spread of ________ feet at the base, and corner posts 2½"x2½". The stub tower shall be approximately ________ feet in height.

D-2c. Girts. Shall be of angle steel of adequate cross-section to give proper stability to the tower specified and spaced approximately 5 feet apart.

D-2d. Braces. Tower shall be adequately braced to prevent twisting or deformation of the tower members. The braces shall be adjustable or capable of giving uniform tension at all times.

D-2e. Galvanizing. All structural parts of the tower shall be galvanized or otherwise treated in an approved manner to resist rust and weather. The galvanizing shall be not less than 2 ounces per square foot of area in accordance with A. S. T. M. Standard A-93-38T or Federal Specifications QQ-I-696 where applicable for Type II, Class C Steel and the test of galvanizing shall be by the triple spot test.

D-2f. Pump Pole Guides. Tower shall be equipped with sufficient pump pole guides to keep the pump pole in proper alignment without binding or interfering with the action of the rod.

D-2h. The tower and windmill shall be erected in a workmanlike manner, all bolts and braces to be securely tightened. The anchor posts shall be securely anchored by placing large rocks or concrete over the anchor and the dirt tamped or tightly compacted.

Prices

These specifications cover complete windmill and tower units. Where prices are asked for on less than complete units, only the portions of the specifications pertaining to those parts are applicable. The bid price shall include setting up the

unit complete and ready for operation. Bids will be accepted on the following:

ALTERNATE NO. ____________________

Alternate No. 1
Windmill only: Diameter ________ ft. Ea. ______________.____

Alternate No. 2
Windmill: Diameter ____________ ft. with
______ ft. stub tower Ea. ______________.____

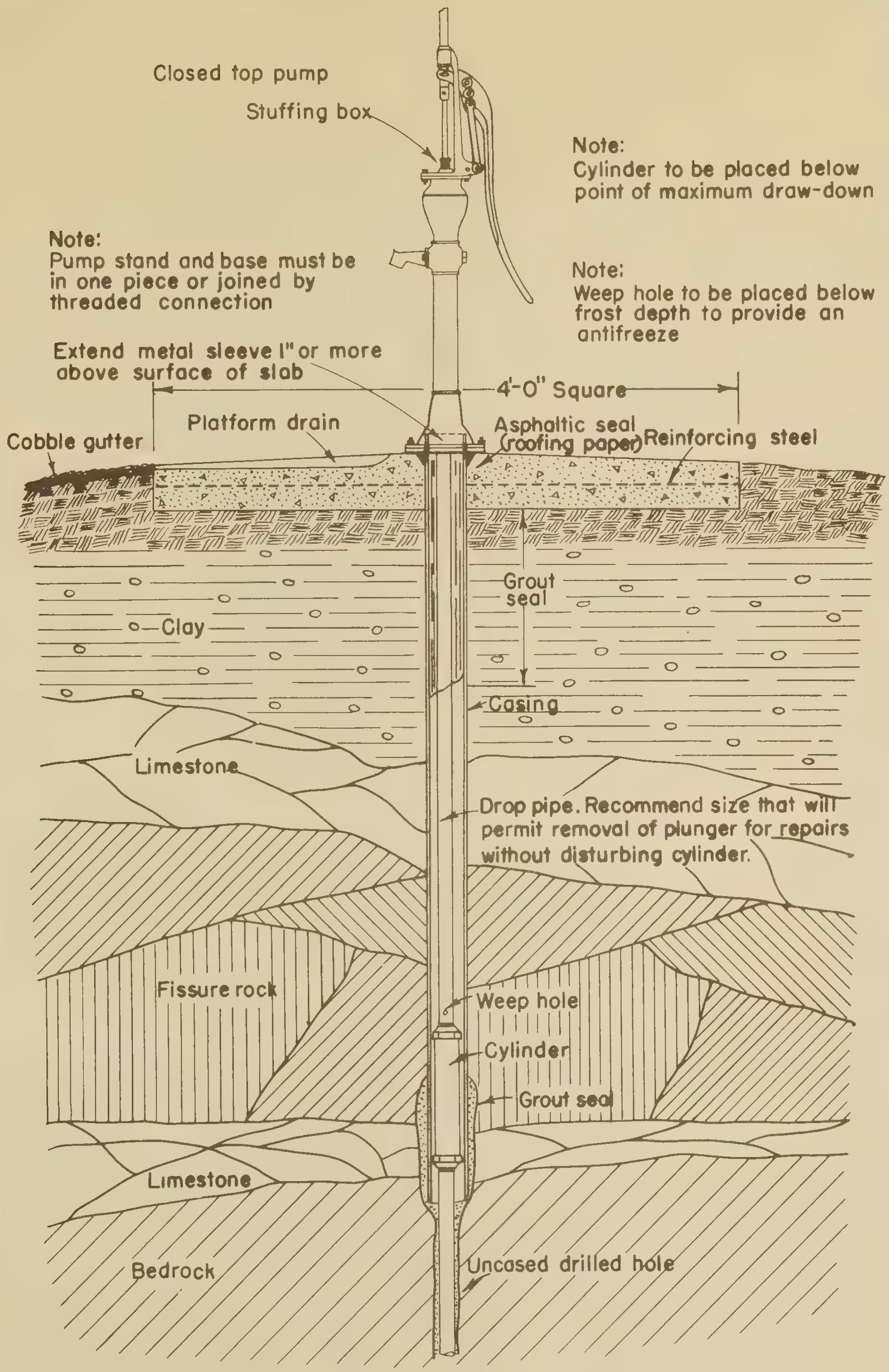
Alternate No. 3
Tower only: Complete,

Height, ____________________ ft. Ea. ______________.____

Alternate No. 4
Windmill: Diameter ____________ ft.
with ____________ ft. tower complete Ea. ______________.____

U.S. Department of Agriculture

Farm Security Administration



DRILLED WELL

FIG. 1

U.S. Department of Agriculture

Farm Security Administration

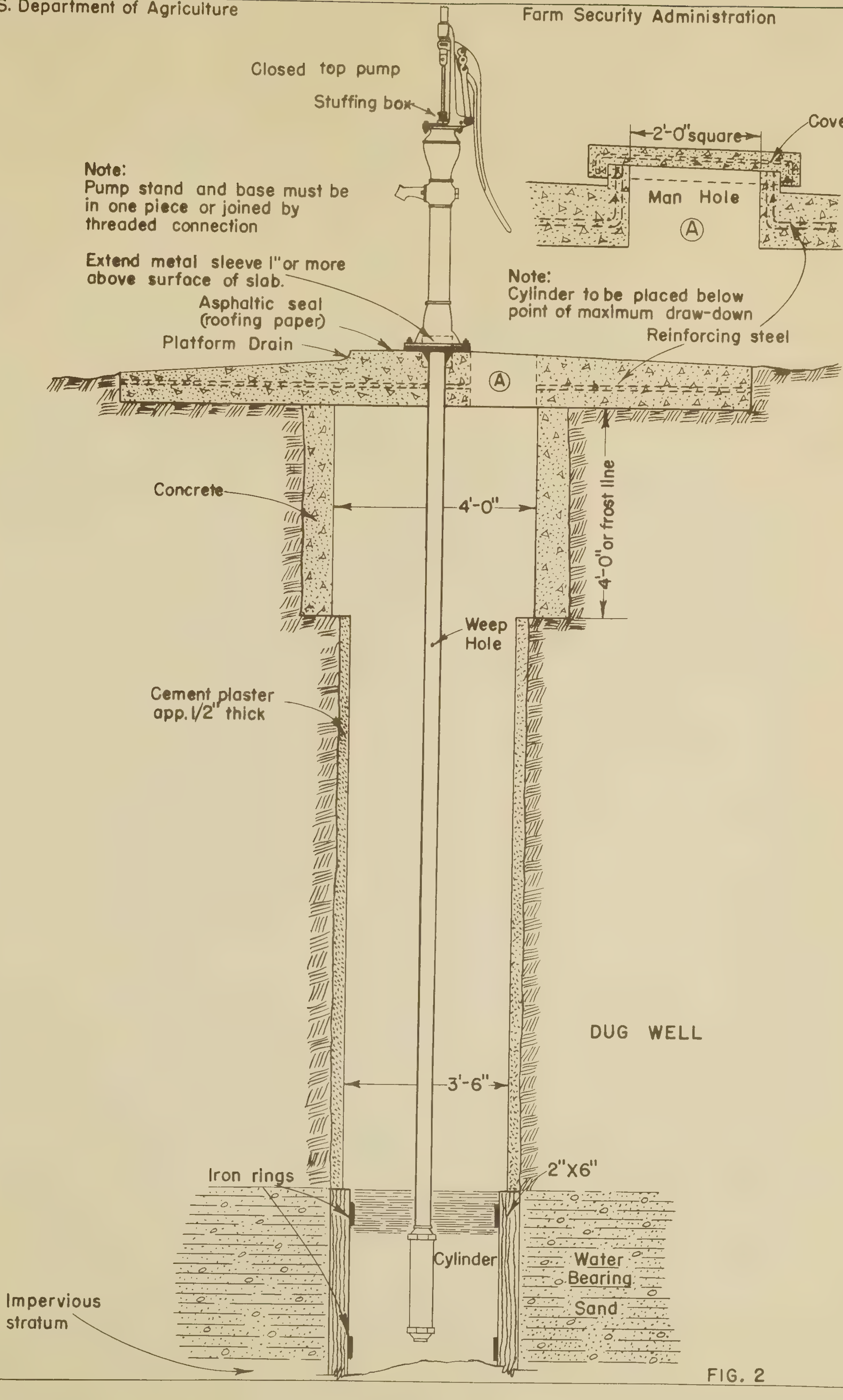
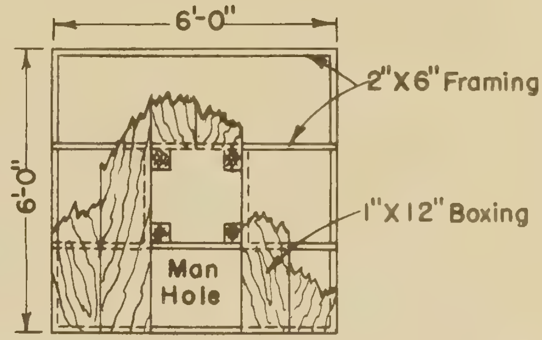
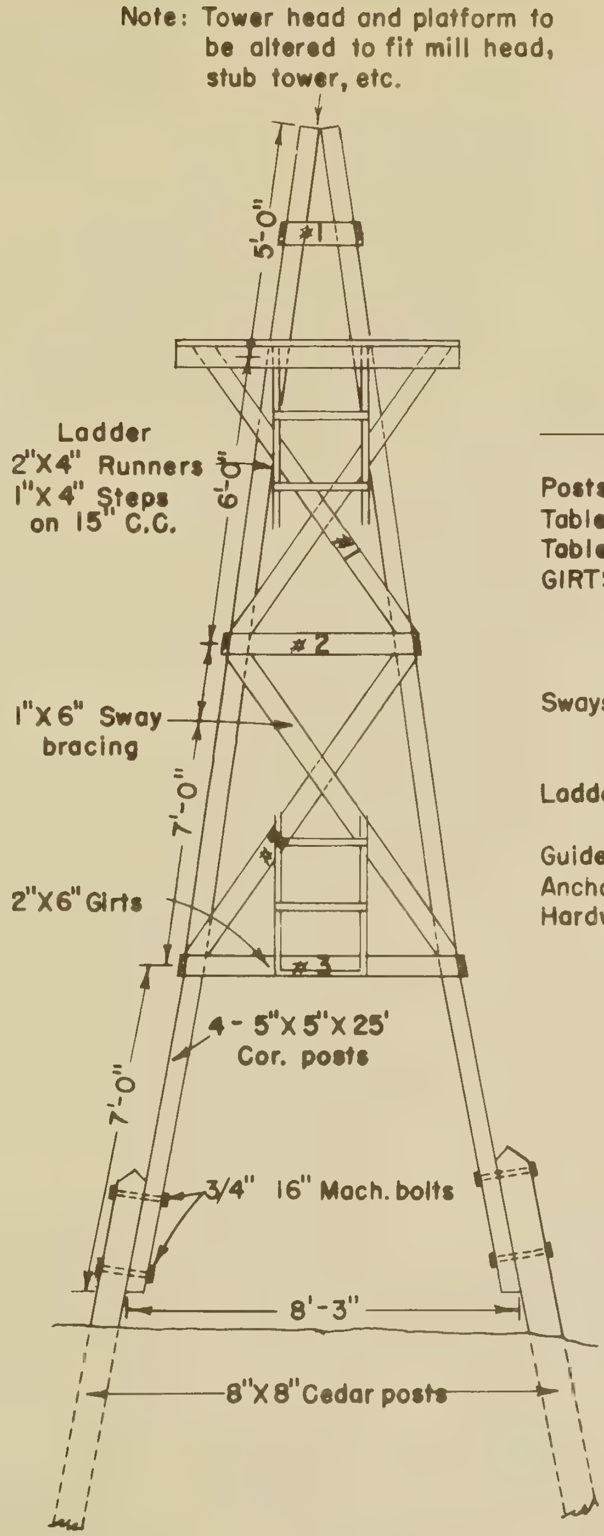


FIG. 2



PLATFORM



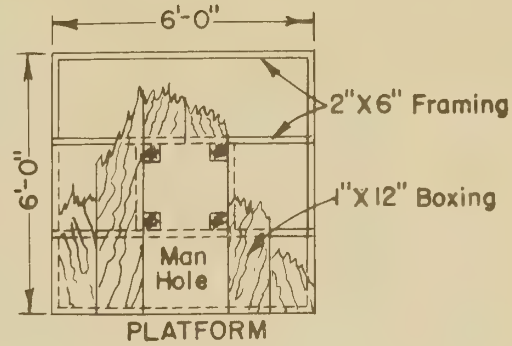
MATERIALS

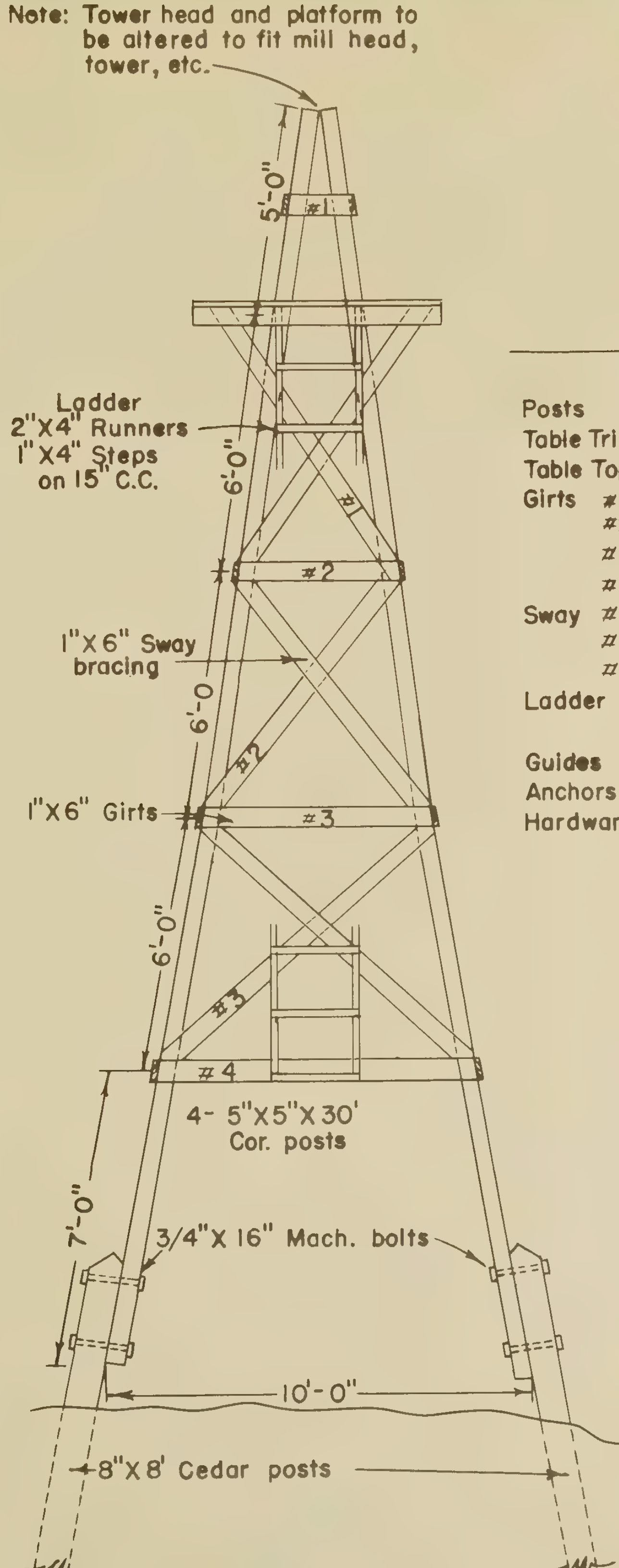
	PCS	Dimen.	Grade	Bd.Ft.
Posts	4	5"X5"X25'		208
Table Trim.	6	2"X6"X6'	#1S4B	36
Table Top	6	1"X12"X6'	#2 Box.	36
GIRTS #1	6	2"X6"X2'	#1S4S	12
#2	4	2"X6"X4'	"	16
#3	4	2"X6"X6'	"	24
Sways #1	4	1"X6"X16'	#1Rgh.	32
#2	4	1" 6" 18'	"	34
Ladder	2	2"X4"X20'	#2S4S	27
	2	1"X6"X16'	#1S4S	16
Guides	2	2"X6"X6'		12

Anchors 4 Cedar Posts 8" top 8' long
Hardware 8 3/4"X16" Mach. Bolts
Nails
8d 2 lbs. Ladder
16d 6 lbs. Sways
20d 8 lbs. Girts & Ladder
Washers.
3/4" Flat wr't. 3 lbs
Paint
2½ gals. mixed, barn

SPECIFICATION "B"
25 FT. TOWER
WOOD WINDMILL TOWER

FIG. 3





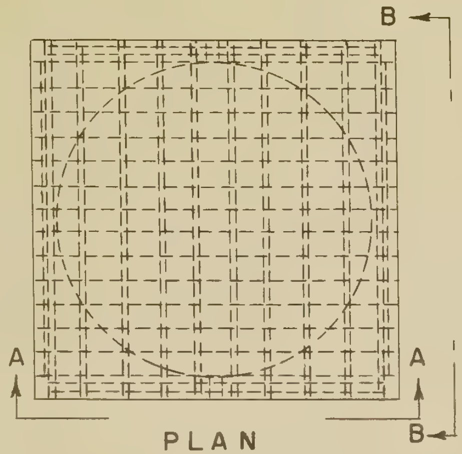
MATERIALS

	PCS	Dimen.	Grade	Bd. Ft.
Posts	4	5"X 5"X 3'		250
Table Trim.	6	2"X 6"X 6'	1S4S	36
Table Top	6	1"X 12"X 6'	2 Box.	36
Girts #1	6	2"X 6"X 2'	1S 4S	12
#2	4	2"X 6"X 4'	"	16
#3	4	2"X 6"X 6'	"	24
#4	4	2"X 6"X 8'	"	32
Sway #1	4	1"X 6"X16'	1 Rgh.	32
#2	4	1"X 6"X16'	"	32
#3	4	1"X 6 X18	"	36
Ladder	2	2"X 4"X20'	2S4S	27
	2	1" X 6"X16'	1S4S	16
Guides	2	2"X 6"X 6'		12

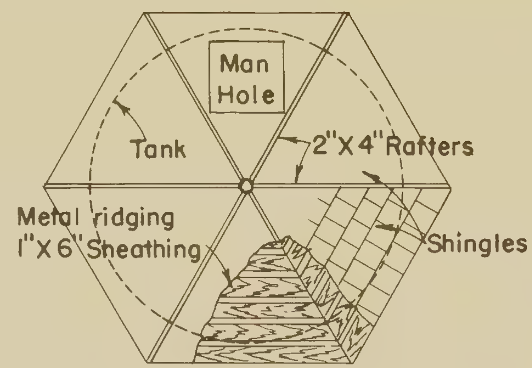
Anchors 4 Cedar posts 8" top 8' long
Hardware 8 3/4"X 16" Mach. bolts
Nails
8d 3 lbs. Ladder
16d 8 lbs. Sways
20d 10 lbs. Girts & Ladder
Washers
3/4" Flat wr't. 3 lbs.
Paint
3 gals. mixed, barn

SPECIFICATION "A"
30 FT. TOWER
WOOD WINDMILL TOWER

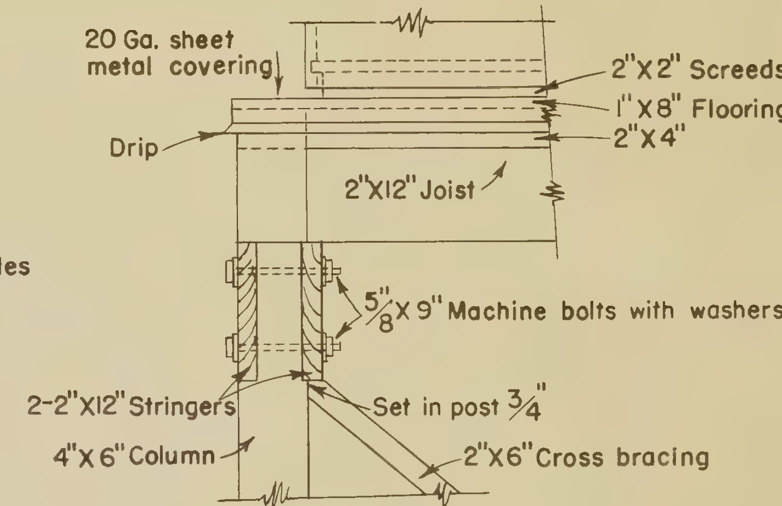
FIG. 4



PLAN



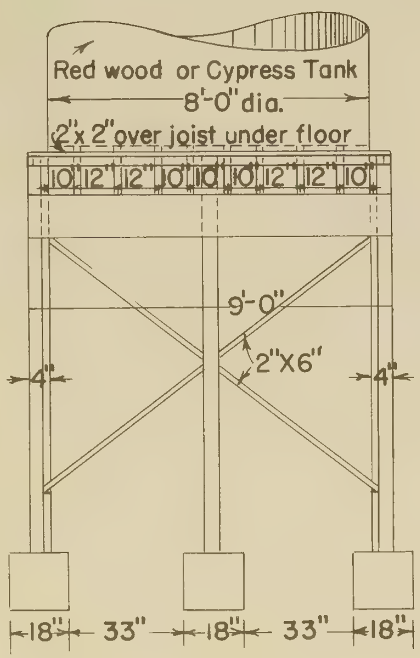
ROOF PLAN



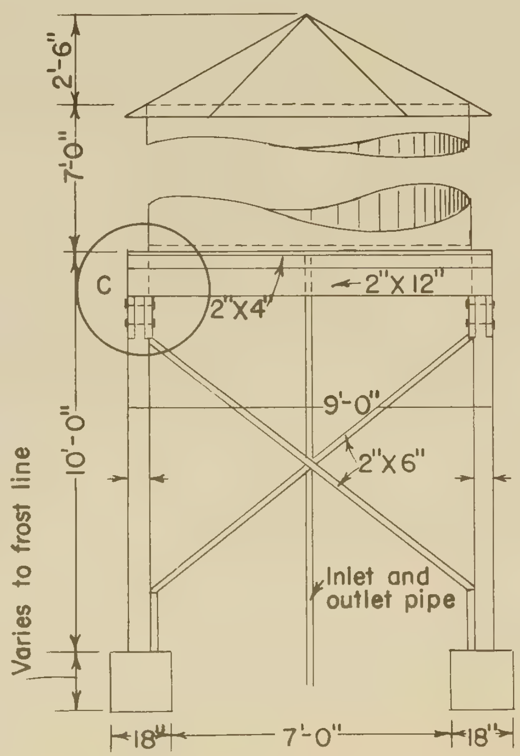
DETAIL C

Bill of Materials			
Unit	Size	Grade & Material	Use
6	4"x6"x10'-0"	No.1 S4S fir or yell. pine	columns
7	2"x12"x18'-0"	" " " " " "	joists & stringers
1	2"x12"x8'-0"	" " " " " "	cent. joist bl'king
4	2"x6"x20'-0"	" " " " " "	cross bracing
2	2"x4"x18'-0"	" " " " " "	cover support
8	1"x8"x18'-0"	" " " " " "	flooring
6	2"x2"x8'-0"	" " " " " "	screeds
2	2"x2"x6'-0"	" " " " " "	"
12	5/8"x9"	Machine bolts	string. to column
6	1/2"x5"	" "	anchor belts
6	1/4"x2"x2'-0"	Flat steel	anchors
3 lb.	5/8"	Flat wr't. washers	
1 lb.	1/2"	" " "	
8 lb.	16 d	Box nails	bracing-toe nail
2 lb.	8 d	" "	flooring
		Cement	As required
		Sand & gravel	" "
		Paint	" "
		Sheet metal covering	" "

Note: Tank & roof material not included in bill of materials



ELEVATION AA

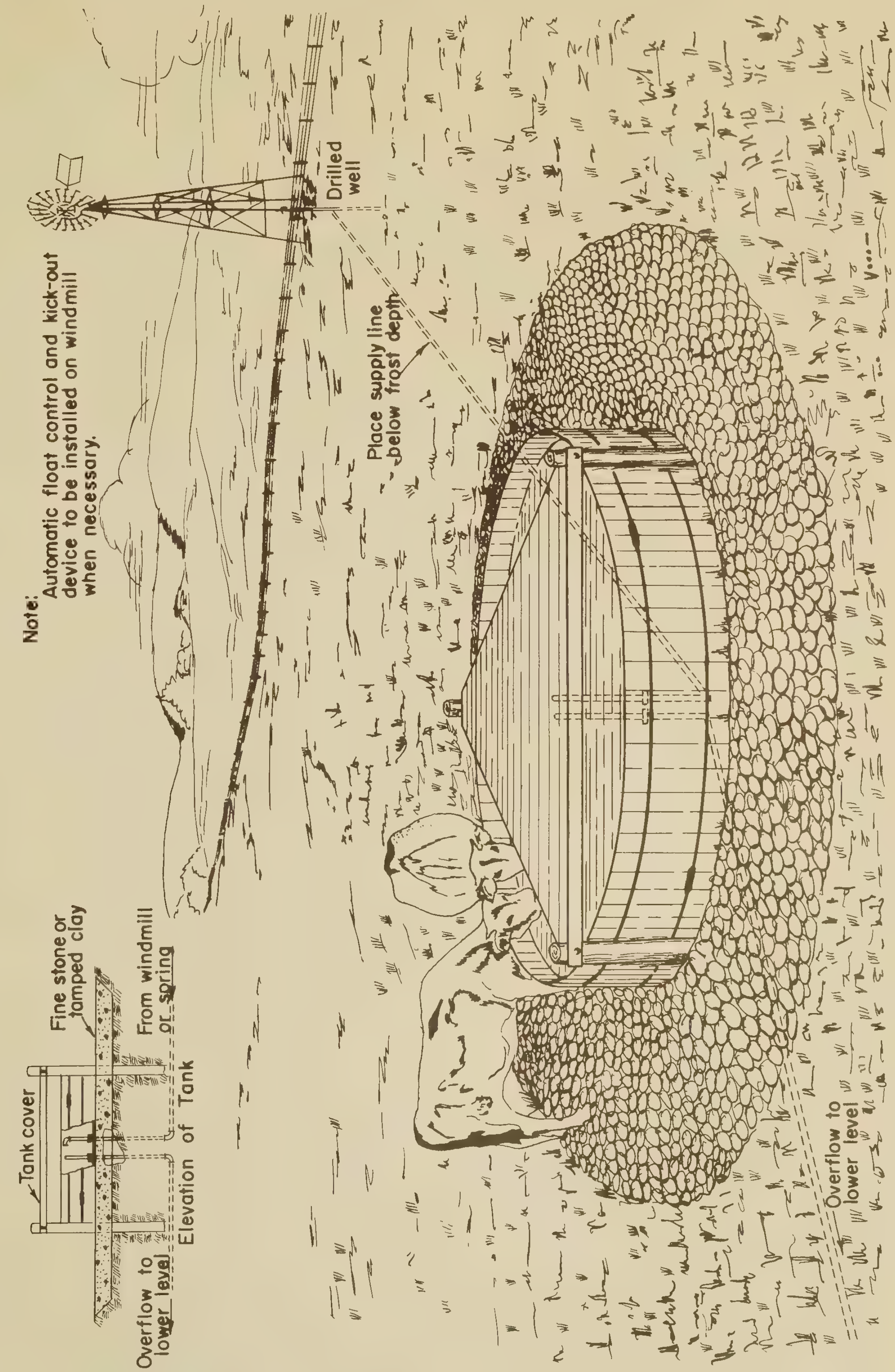


ELEVATION BB

TANK TOWER 80 BBL. CAPACITY

FIG. 5

U. S. Department of Agriculture Farm Security Administration



TYPICAL WINDMILL INSTALLATION FOR CATTLE WATERING TANKS

FIG. 6

U.S. Department of Agriculture

Farm Security Administration

Note:
Plastered cistern to be constructed only in a firm soil that will stand plastering and which is dry or well drained so that the danger of seepage into cistern is eliminated.

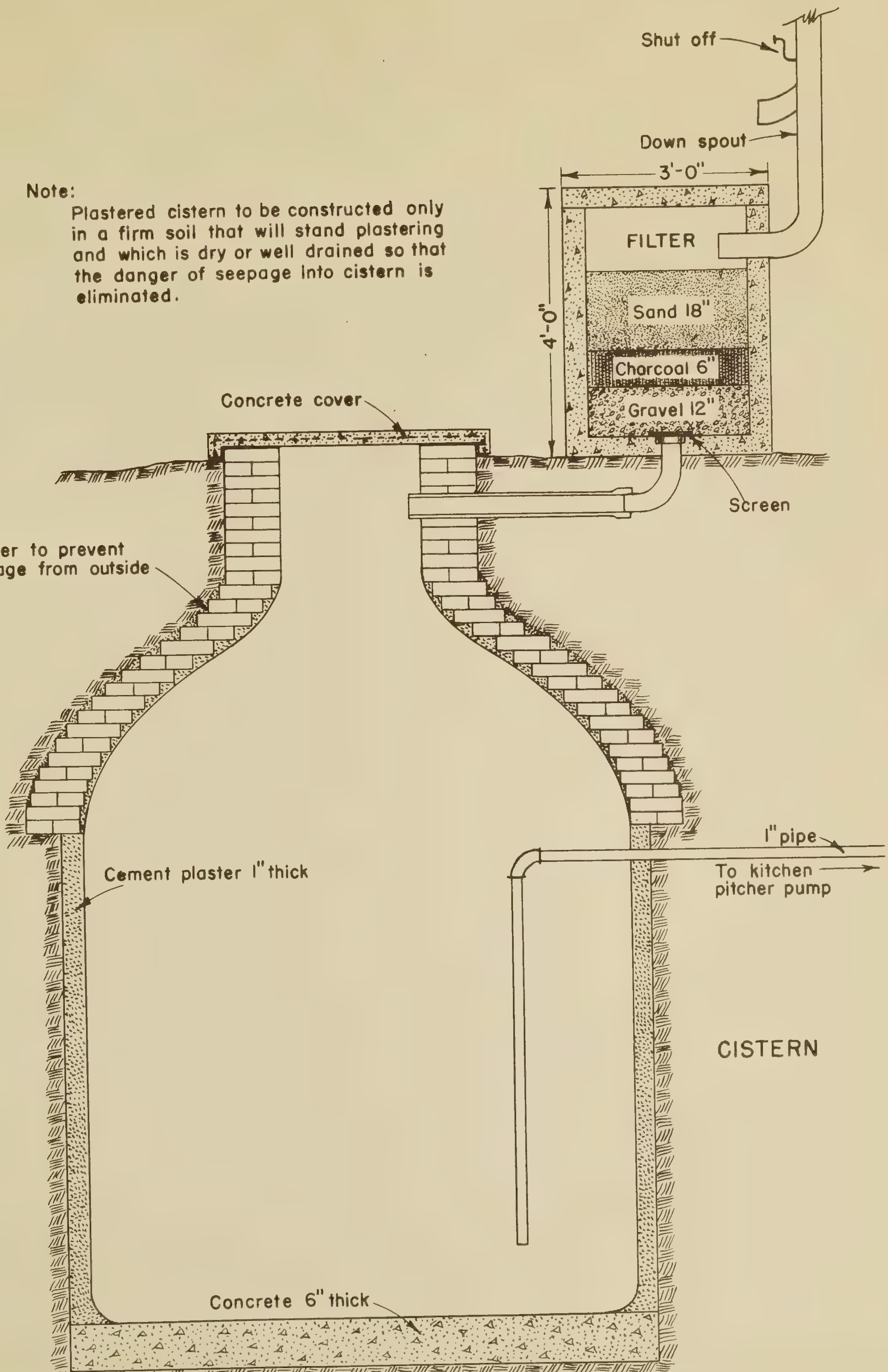


FIG. 7

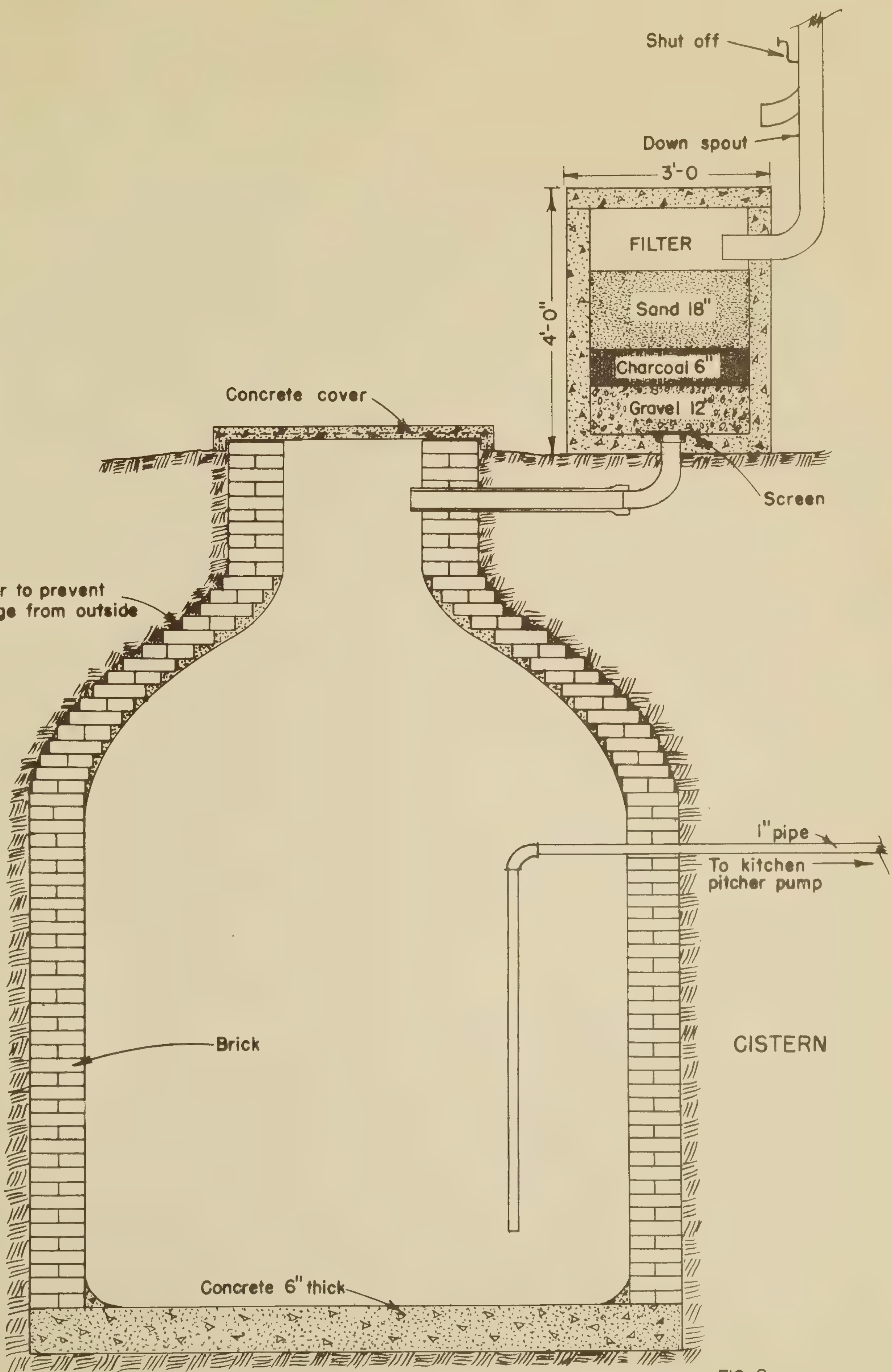

Shut off
Down spout
3'-0
4'-0"
FILTER
Sand 18"
Charcoal 6"
Gravel 12"
Screen
Concrete cover
Plaster to prevent seepage from outside
1" pipe
To kitchen pitcher pump
Brick
CISTERN
Concrete 6" thick

FIG. 8

U. S. Department of Agriculture

Farm Security Administration

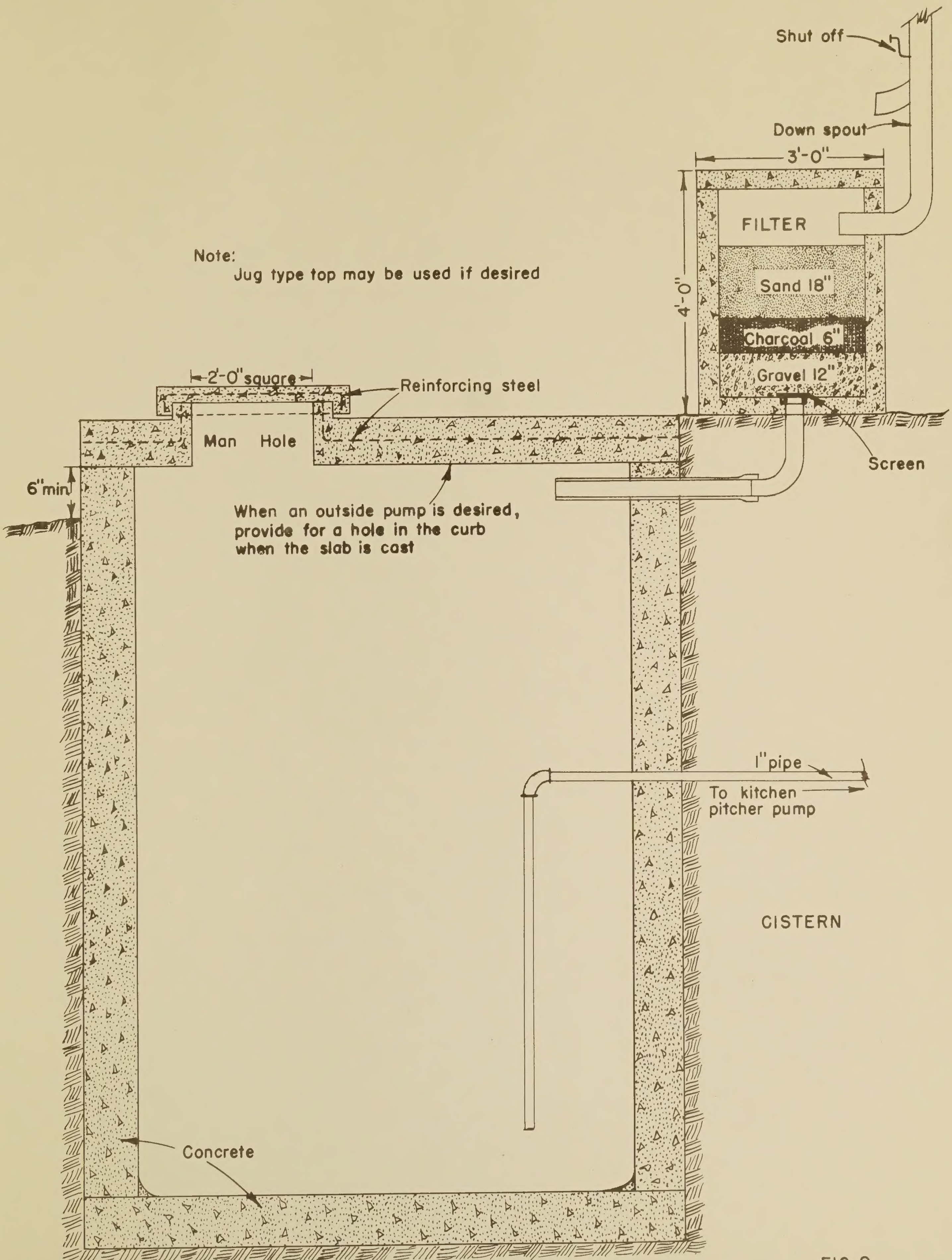


FIG. 9